

AGING IN THE LARGE CDF AXIAL DRIFT CHAMBER

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This is a short summary for the talk on aging in the Central Outer Tracker (COT) in the Collider Detector at Fermilab. The work is ongoing, so at this time it is not possible to know what our understanding of the situation will be the time of the conference. This brief note summarizes our current understanding.

The COT is a large axial drift chamber in the Collider Detector at Fermilab. The chamber is approximately 3 meters long by 3 meters in diameter with a gas mixture that is 50/50 argon/ethane with a admixture of 1.7% isopropanol. The COT has experienced unexpected aging with the worst parts of the chamber showing a gain loss of 50% for an accumulated charge of about 40 mC/cm.

The amplifier/shaper/discriminator mounted on the chamber face generates a logic pulse whose length is proportional to the integrated charge in the input pulse. By looking at the average width of hits on good tracks, it is possible to monitor the gain of chamber wires as a function of time and location in the chamber. Figure 1 shows the z dependence of the widths in one of the inner superlayers (SL2). The blue points are for an early run with little or no aging and the red points are for a recent run showing considerable aging. Figure 2 shows the widths as a function of cell number (ϕ).

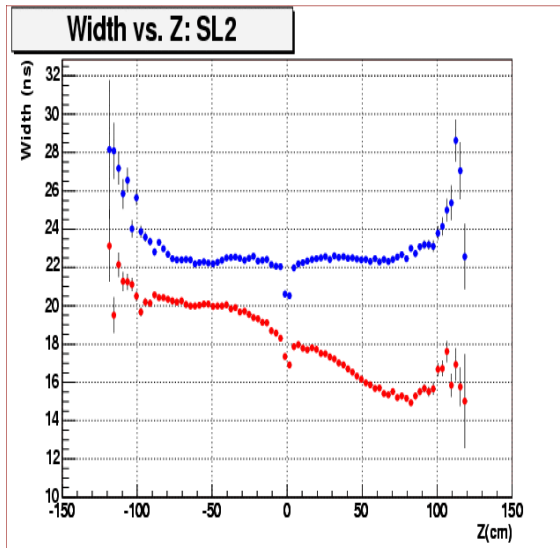


Figure 1. Z dependence of SL2 widths (gain).
Blue is early data showing little or no aging.

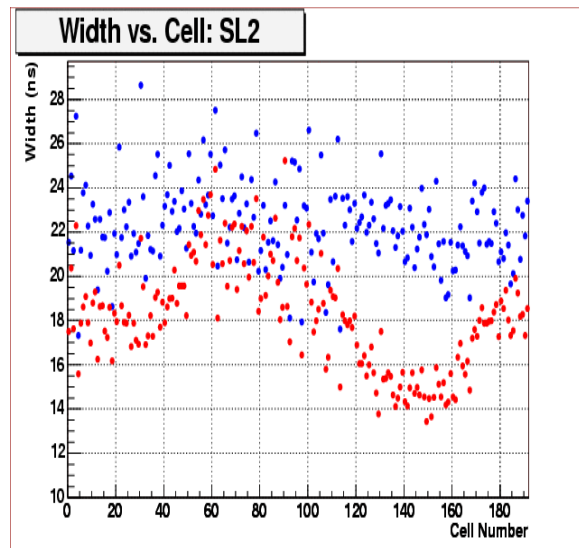


Figure 2. Phi (cell) dependence of SL2 widths.
Red is recent data with structure due to aging.

In addition, the archive of the currents of the high voltage (HV) supplies gives an another monitor of chamber gain and its dependence on the instantaneous charge deposition rate and the recent history of this rate. Figure 3 shows the ratios of the HV currents to luminosity versus the integrated charge per centimeter of wire in SL8 (outermost

superlayer with little aging) for several superlayers since early April 2003. The integrated charge/cm in SL1 and SL2 is about 5.5 times that in SL8.

Chambers monitoring the gas quality with localized radiation sources have experienced no aging. The aging in the COT is worse on the exhaust end of the chamber consistent with polymer buildup as the gas flows through the chamber. The distribution in azimuth suggests that aging is enhanced at lower temperatures, but other factors such as gas flow patterns may be involved.

Elemental and molecular analysis of the sense wires found a coating that is mostly carbon and hydrogen with a small amount of oxygen; no silicon or other contaminants were identified. High resolution electron microscope pictures of the wire surface show that the coating is smooth with small sub-micron nodules. Figure 4 shows an electron microscope picture for a wire in SL2 and Figure 5 shows an EDS spectrum for the same wire.

Our current understanding of the aging experienced by the COT and the procedures we have implemented to solve the aging problem will be presented.

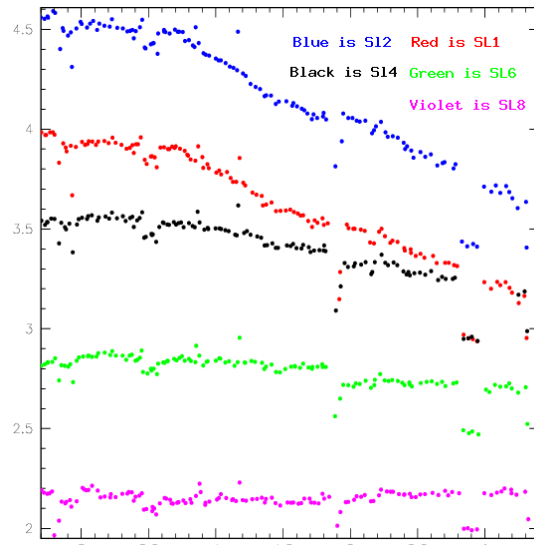


Figure 3. HV current/luminosity vs integrated charge (mC/cm) for SL8.

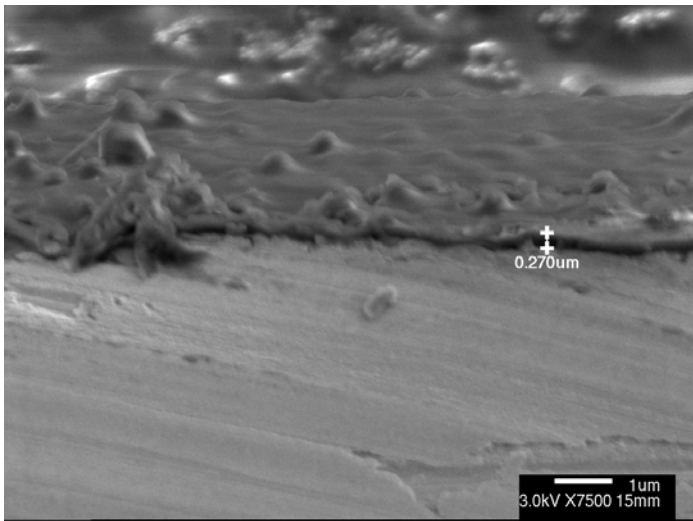


Figure 4. Electron microscope picture of the coating on SL2 sense wire. The foreground is bare wire and behind it is a smooth dark coating with nodules. In the background is the black tape holding the wire.

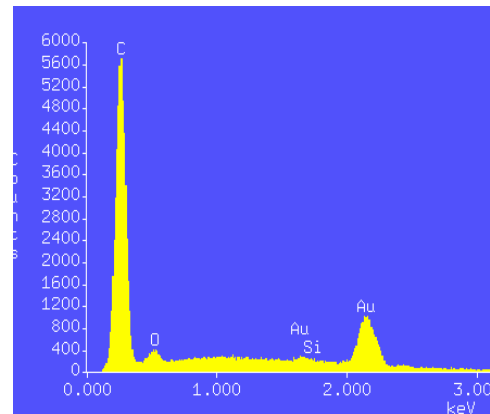


Figure 5. EDS spectrum of SL2 wire coating showing mostly carbon with some oxygen in addition to the gold.